# New Policies for the New Economy

# Cluster-based Innovation Policy:
## International Experiences[1]

Th.J.A. Roelandt

V.A. Gilsing

J. van Sinderen

Dutch Ministry of Economic Affairs/OCFEB

*Paper presented at the 4th Annual EUNIP Conference*

*Tilburg, The Netherlands*

*7-9 December 2000*

---

[1]  Based on the work of OECD-Focus Group on Cluster Analysis and Cluster-based Policy as reported in OECD (1999). Corresponding author: t.j.a.roelandt@minez.nl

Research Memorandum 0012

OCFEB
Room  H6-21
Erasmus University Rotterdam
P.O. Box 1738
3000 DR Rotterdam
The Netherlands
Telephone +31 10 408 2430
Telefax  +31 10 408 9173
E-mail  info@ocfeb.nl
Website  www.ocfeb.nl

# Table of contents

## 1.    Cluster analysis and the system of innovation approach

Understanding technical change and innovation is crucial for understanding the dynamics of 'knowledge based economies' (OECD, 1996) and 'learning economies' (Lundvall and Borrás, 1997). Differences in innovation performance and the related institutional setting of a country, partly explain variations in economic performance. In modern innovation theory the strategic behaviour and alliances of firms, as well as the interaction and knowledge exchange between firms, research institutes, universities and other institutions, are at the heart of the analysis of innovation processes. Innovation and the upgrading of productive capacity is seen as a dynamic social process that evolves most successfully in a network in which intensive interaction exists between those 'producing' and those 'purchasing and using' knowledge. As a result both innovation researchers and innovation policy-makers increasingly focus on the efficiency and efficacy by which knowledge is generated, diffused and used and on the dynamics of the related networks of production and innovation. Increasingly the notion *National Innovation System* (NIS) is used as conceptual framework for discussing these type of linkages and interactions among the numerous actors involved in processes of innovation.

Since its launching in the second half of the eighties NIS has developed into a widely used theoretical framework, analytical instrument and – increasingly – gained popularity as a framework for innovation policy-making. In the literature, the notion of NIS is defined differently.[2] Freeman (1987) for example originally defined it as the "network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies". Lundvall (1992) in his major contribution defined NIS as "the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge (…) and are either located within or rooted inside the borders of a nation state". Metcalfe (1995) describes NIS as "that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies". Despite this conceptual variations, the literature on innovation systems has underpinned two essential dimensions of innovations:

---

[2]    Given these various definitions it is not surprising to find key elements of NIS such as 'innovation', 'system', 'national' and 'institution' interpreted quite differently by the various scholars. Therefore it can even be said that the notion of NIS itself is 'conceptually diffuse' (Edquist, 1997, p. 27). Major contributions include Freeman (1987), Lundvall (1992) and Nelson (1993). A fine overview of the characteristics as well as differences between the various systems of innovation approaches is provided by Edquist (1997).

- The interaction between different actors in the innovation process, particularly between users and producers of intermediate goods and between business and the wider research community, is very important for successfully innovating.
- Institutions matter as innovation processes are institutionally embedded in the setting of networks of production.

Although there are more reasons to explain the popularity of the NIS approach, the value added of it basically boils down to two main characteristics: (a) the networking or *interdependency* element and related to this (b) the *systemic* character of the NIS approach.

*Networking and interdependency*

Theory and practice have revealed that the interaction between the different agents involved in the process of innovation is quite important for successfully innovating (see Morgan, 1996; Lagendijk and Charles, 1999). Firms almost never innovate in isolation (DeBresson, 1996). Networks of innovation are the rule, not the exception, and most innovative activity involves multiple actors (OECD, 1997, p. 3). Figure 1 illustrates the importance of network relations in clusters when innovating.[3] Most of the innovative firms in the clusters are co-operating with suppliers, competitors, clients or equipment suppliers. Innovative firms need tight relations with suppliers and clients, which have complementary technology and competencies.
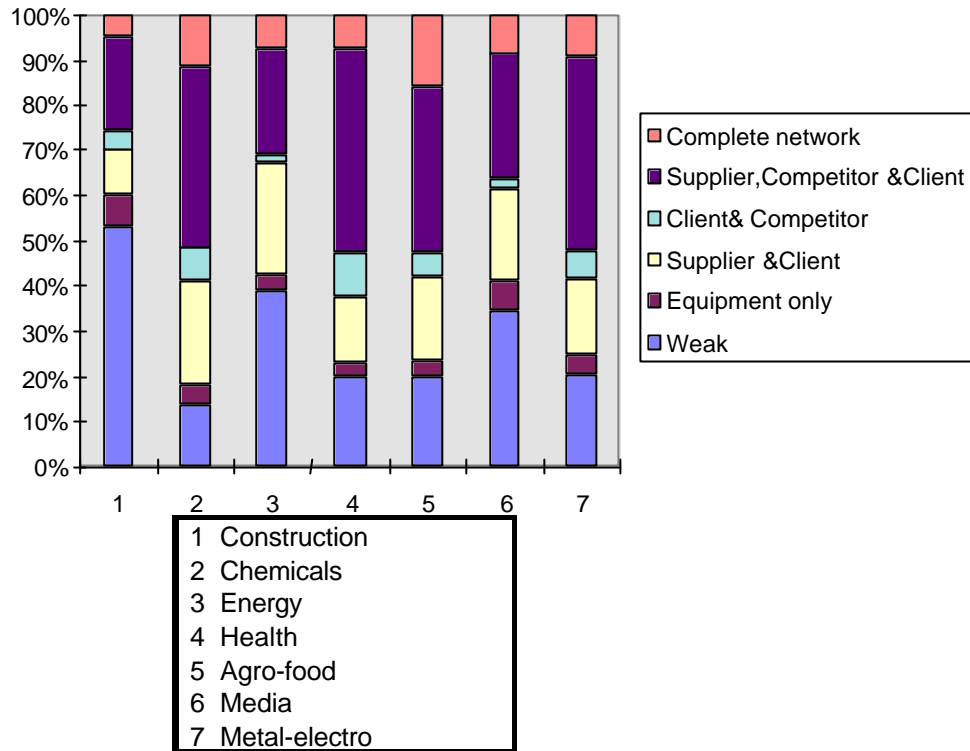
---

[3]  Van den Hove et al (1998).

*Figure 1 - Networks of innovation in clusters in the Netherlands, 1992*[4]

For successfully innovating companies are becoming more dependent upon complementary knowledge and know-how in companies and institutions other than their own. Innovation is not so much the activity of a single company (like the 'heroic Schumpeterian entrepreneur'), but requires an active search process to tap new sources of knowledge and technology and to apply them to products and production processes. A firm's competitiveness is becoming more dependent upon the ability to apply new knowledge and technology in products and production processes. At the same time, the rate of specialisation is also on the increase (Yoshitimo, 1997). Companies are developing strategies to cope with the increasing dependency upon their environment by a more flexible organisation and the integration of various links in the production chain through entering strategic alliances, joint ventures and consortia. This process of division of labour between dissimilar and complementary firms is based on the strategic choice firms have to make between internalising knowledge or sharing information with

---

[4]     For further details, see Van den Hove et al (1998).

external actors. The main goals of most strategic alliances have been to gain access to new and complementary knowledge and to speed up the learning processes. There has been a shift  by firms towards dis-internalising activities along and between value chains and towards specialisation on those activities that require resources and capabilities in which firms already have or can easily acquire competitive advantage. In the literature the concept of *alliance capitalism* (Dunning, 1997) is used to indicate this new stage in the development of modern economic systems: the co-existence of competition, sharpened by globalisation and liberalisation, with an increasing number of network relations and strategic alliances.

*Systemic character*
A second major contribution of the NIS approach is its *systemic character*. Innovation is no longer perceived as a linear process, but as the result of a complex interaction between various actors and institutions. These various actors and institutions and their interconnections constitute a *system* of strongly interdependent agents. This implies that not only actors, but also institutions play a major role when innovating. Institutions can be interpreted in a narrow sense e.g. organisations such as universities, research organisations, financial institutions or all kind of brokerage organisations that are in one way or the other involved in innovation processes. Institutions can also be interpreted more broadly and in addition include 'behaviour' as these are reflected in for example routines, norms, rules, laws or even more generally: 'the way things are usually done'.[5]

The systemic character of the NIS concept makes it an appealing and useful tool for understanding the dynamics of innovation. Because of this the NIS way of thinking is increasingly used by policy-makers as a framework for industrial and/or innovation policy-making, as will be illustrated in this publication. Although the systemic role of government is still a matter of debate, an increasing number of countries are actually focusing on removing systemic imperfections and on improving the efficient functioning of their systems of innovation (see section 3 of this paper).

Edquist (1997) pointed out that the NIS concept is in fact a specific type of a much larger family of  'systems of innovation' approaches which have system analysis as their common starting point but differ in the object and level of analysis (supranational, regional, sectoral or technological systems of innovation, clusters).[6] In this paper we discuss a perspective on the innovation system approach which focuses on networks of production and value chains. Economic *clusters* can be characterised as being networks of production of strongly interdependent firms (including specialised suppliers) linked to each other in a value-adding production chain. In some cases clusters also encompass strategic alliances with universities, research institutes, knowledge intensive business services, bridging institutions (brokers, consultants) and customers. Clusters defined in

---

[5]  Edquist (1997, p. 26) – as well as others – have pointed at the conceptual ambiguity surrounding the term institution.
[6]  Edquist (1997), p. 3-15.

this way can be interpreted as innovation systems at a reduced scale level. This implies that similar dynamics, system characteristics and interdependencies as described for national innovation systems exist for specific clusters.

The cluster approach provides quite a number of advantages over the traditional sectoral perspectives when analysing innovation and innovation networks. These advantages are not limited to the analysis of innovation processes, but extend to the realm of innovation policy-making as well. Cluster-based policy aims at removing imperfections of innovation systems (systemic imperfections) by facilitating the efficient functioning of these systems. The main aim of this study is reviewing cluster methodologies, cluster analyses as well as cluster-based policy initiatives.

## 2. Cluster analysis methodologies

*What is new in cluster analysis?*
The cluster concept focuses on the linkages and interdependence between actors in the value chain when producing products and services and creating innovations. The cluster concept goes beyond 'simple' horizontal networks in which firms, operating on the same end product market and belonging to the same industry group, co-operate on various aspects (like joint R&D, demonstration programmes, collective marketing or joint purchasing policy). Clusters most often are cross-sectoral (vertical and/or lateral) networks and contain dissimilar and complementary firms specialised around a specific link or knowledge base in the value chain.

**Table 1 – Traditional sectoral approach versus cluster-based approach**

| *Sectoral approach* | *Cluster-based approach* |
|---|---|
| • Groups with similar network positions | • Strategic groups with mostly complementary and dissimilar network positions |
| • Focus on end product industries | • Include customers, suppliers, service providers and specialised institutions |
| • Focus on direct and indirect competitors | • Incorporate the array of interrelated industries sharing common technology, skills, information, inputs, customers and channels |
| • Hesitancy to co-operate with rivals | • Most participants are not direct competitors but share common needs and constraints |
| • Dialogue with government often gravitates towards subsidies, protection and limiting rivalry | • Wide scope for improvements on areas of common concern that will improve productivity and raise the plane of competition<br>• A forum for more constructive and efficient business-government dialogue |
| • Looking for diversity in existing trajectories | • Looking for synergy and new combinations |

Source: Adapted from Porter (1997)

By specifying strict boundaries for industries or sectors (mostly based on some statistical convention), the traditional research approach fails to take into account the importance of interconnections and knowledge flows within a network of production (Rouvinen & Ylä-Anttila, 1999). Compared to the traditional sectoral approach, which focuses on strategic groups of similar firms with similar network positions, the cluster concept offers a new way of looking at the economy and is more in line with the modern and interactionistic innovation theory, with changed market developments and with the changing character of market-based capitalism (Dunning, 1997; Roelandt et al, 1999). The sectoral approach focuses on horizontal relations and competitive interdependence (relations between direct competitors with similar activities and operating in the same product markets) whereas the cluster approach in addition focuses at the importance of vertical relationships between dissimilar firms and symbiotic interdependence in the value chain (Pfeffer and Salancik, 1978). Although innovations are stimulated by the horizontal struggle between competitors operating on the same product markets, vertical relations between suppliers, main producers and users are also important for creating innovations.

Table 1 adopted with changes from Porter's work (1997), summarises the main differences between the traditional sectoral approach and the cluster-based approach.

In practice the incentives for cluster formation differ quite considerably. The *principle incentives for cluster formation* [7] are: (i) to gain access to new and complementary technology; (ii) to capture economics of synergy or economies of interdependent activities; (iii) to spread risks; (iv) to promote joint R&D efforts with suppliers and users; (v) as a defensive strategy to reduce competition; (iv) to obtain reciprocal benefits from the combined use of complementary assets and knowledge; (v) to speed up the learning process; (vi) to lower transaction costs; and, (vii) to overcome (or to create) entry barriers in markets.

*Various approaches*
In the literature the *analysis of linkages and interdependence* between actors in a value chain or innovation system is carried out *at different levels of analysis* and with *different techniques,* depending on the questions to be answered (Roelandt and Den Hertog, 1999).

Table 2 presents the *various levels of analysis*, using variations on the cluster concept and a different focus of the analysis. Some studies focus on the *firm level* and analyse the competitiveness of a *network of suppliers around a core enterprise*. This kind of analysis is used to make a strategic analysis of the firm and to identify missing links or strategic partners when innovation projects encompass the whole chain of production. In this case, cluster analysis is directly linked to action and strategic business

---

[7]    In fact the incentives mentioned apply for creating cross-border strategic alliances as well (Dunning, 1997, Boekholt and Thuriaux, 1999, Porter, 1997, and Hagendoorn, 1993)

10

development (like the Ottawa cluster in Heath (1999)). Other contributions concentrate at the *meso-level*, mostly conducting some kind of SWOT- or benchmark analysis at the level interrelated branches in a value chain. In a way, most of the Porter studies carried out in different countries (Finland, Sweden, USA, Denmark, the Netherlands) use this level of analysis. And finally some countries' contributions focus on linkages within and between *industry groups* (mega-clusters, like for instance Finland and The Netherlands), mapping specialisation patterns of a country or region economy-wide (*macro-level*).

**Table 2 – Cluster analysis at different levels of analysis**

| *Level of analysis* | *Cluster concept* | *Focus of analysis* |
|---|---|---|
| National level (macro) | Industry groups linkages in the economic structure | • Specialisation patterns of a national/regional economy<br>• Need for innovation and upgrading products and processes in mega-clusters |
| Branch or industry level (meso) | Inter- and intra-industry-linkages in the different stages of the production chain of similar end product(s) | • SWOT- and benchmark-analysis of industries<br>• Exploring innovation needs |
| Firm level (micro) | Specialised suppliers around one or a few core enterprises (inter-firm linkages) | • Strategic business development<br>• Chain analysis and chain management<br>• Development of collaborative innovation projects |

Next to the level of analysis cluster methodologies differ in the various use of techniques. Various categories of *research techniques* are used in the literature, namely:

1. *input-output analysis* focusing on trade linkages between industry groups in the value chains of the economy (see Hauknes, 1999, Roelandt et al, 1999, and Bergman 1999),
2. *graph analysis* founded in the graph theory and identifying cliques and other types of network linkages between firms or industry groups (DeBresson and Hu, 1999),
3. the third category is *correspondence analysis* (like for instance factor analysis, principal components analysis, multi-dimensional scaling and canonical correlation). Basically, all these techniques aim at identifying groups or categories of firms or industries with *similar innovation styles*. (see for example Vock, 1997, Arvanitis and Hollenstein, 1997, and Spielkamp and Vopel, 1999),
4. finally, the qualitative case study approach like the Porter studies conducted in the various countries (Rouvinen and Yla-Anttila, 1999, Dreijer et al, 1999, Stenberg et al, 1997, and Roelandt et al, 1999).

A clear distinction should be made between approaches focusing on linkages between (dissimilar) actors in networks or value chains (approaches 1 and 2) and the general

11

quantitative cluster techniques as such (approach 3) to detect objects with similar characteristics (see for example Meeuwsen and Dumont, 1997). The first group of techniques can be used to identifying network linkages of production or innovation (using input output tables or innovation interaction matrices) and the latter group of techniques can be used to identify different styles of innovation and different styles of division of labour when innovating.[8] Although this latter approach fundamentally differs from the value chain approach, both methodologies can be combined.[9] Finally, it should be remarked that the case study approach (approach 4) has been conducted in numerous countries (among which the United States, Finland, Sweden, Denmark, Italy, The Netherlands), mostly using Porter's diamond and his network approach as a framework for analysing the competitiveness of the local production structure. In most countries these *monographic cluster case studies* have been complemented with statistical analysis. Case study material can provide more in-depth information and can be used to interpret the structures resulting from statistical analysis.

In the various countries in which cluster analysis is practised it resulted in useful information about the actors involved in clusters, value chain relations of firms, innovation interaction linkages as well as the institutional setting of clusters' innovation systems and imperfections of these cluster-based innovation systems. Most of the countries' contributions have in common that they are *on networks of strongly interdependent firms or industry groups*,

- in some cases based on *trade linkages* (Hauknes, 1999, Roelandt et al, 1999, and Bergman and Feser, 1999),
- sometimes on *innovation linkages* (DeBresson and Hu, 1999),
- sometimes on *knowledge flows linkages* (Viori, 1995, Poti, 1997, Roelandt et al, 1999, and Van den Hove et al, 1998), and
- sometimes based on a *common knowledge base or common factor conditions* (Dreijer et al, 1999).

The common starting point of all these perspectives is the assumption that firms need a network of suppliers, customers and knowledge producing agents to innovate successfully. Most cluster analyses use a combination of different techniques at different levels of aggregation. Table 3 summarises how the variety on both level of analysis and cluster techniques as well cluster concept used works out for a number of countries. Most countries combine various techniques to overcome the limitations of using one single technique as different methodologies answer different questions and provide different sorts of information.

---

[8]     Some countries, like Switzerland and Germany, focus on this element, assessing categories of firms having the same type of innovation styles, knowledge sources and knowledge transfer mechanisms and identifying success factors for innovation. (see for example Vock, 1997, Arvanitis and Hollenstein, 1997, and Spielkamp and Vopel, 1999).

[9]     See for example Van den Hove et al (1998).

**Table 3 – Level of analysis, cluster technique and cluster concept adopted in various countries**

| Country | Level of analysis | | | Cluster technique | | | | | Cluster concept |
|---|---|---|---|---|---|---|---|---|---|
| | micro | meso | macro | I/O | Graph | Corres | Case | Other | |
| AUS | | x | x | X | | x | x | | Networks of production, networks of innovation, networks of interaction |
| AUT | | x | x | | | | x | Patent data & trade performance | Marshallian industrial districts |
| BEL | x | | | | X | | | Sciento-metrics | Networks or chains of production, innovation and co-operation |
| CAN | | x | x | X | | | x | | Systems of innovation |
| DK | x | x | | X | X | | x | | Resource areas |
| FNL | x | x | | | | | x | | Clusters as unique combinations of firms tied together by knowledge |
| GER | x | x | | X | | x | | | Similar firms and innovation styles |
| IT | | x | | X | | | | | Inter-industry knowledge flows |
| MEX | | x | x | | | | x | | Systems of innovation |
| NL | | x | x | X | | | x | | Value chains and networks of production |
| SP | | x | | X | | | x | | Systems of innovation |
| SWE | | x | | | | | x | | Systems of interdependent firms in different industries |
| SWI | x | x | | | | x | x | Patent data | Networks of innovation |
| UK | x | x | | | | | X | | Regional systems of innovation |
| USA | | x | | X | | | X | | Chains and networks of production |

*What do we learn from cluster analyses?*

The following advantages of cluster analysis have been indicated:
- It offers a new way of thinking about the economy and organising economic development efforts and it is a useful alternative for the limitations of the traditional sectoral analysis.

- Cluster analysis has better aligned with the changed nature of competition and market-based innovation systems and the main sources of competitive advantage.
- Cluster analysis captures important linkages in terms of technology, skills, information, marketing and customer needs that cut across firms and industries. Such linkages and interdependencies are fundamental to the direction and pace of innovation.
- Cluster studies have improved the understanding of innovation systems at a reduced scale level, including systemic imperfections and policy options. Cluster studies have been the corner stone of industrial policy making in a lot of countries. Cluster studies not only provide an analytic tool to analyse systems of innovation, but can also be used as a working method for policy making in this area and as an economic development tool for strategic business development, in industrialised countries as well as in developing countries (Ceglie, 1999).
- Cluster analysis provides options for recasting the role of the private sector, government, trade associations and educational and research institutions and brings together business development opportunities of firms of all sizes and across traditional industry lines.
- Cluster analysis provides a starting point for creating a forum for constructive business-government dialogue. Not only common problems have been identified, but basically cluster analyses identify common development opportunities and highlights attractive public and private investment opportunities.

## 3  Strategies in cluster-based policy

Clustering and networking basically is a bottom-up, market-induced and market-led process. Following the classical line of reasoning the primary task of government should be to facilitate the dynamic functioning of markets and make sure that co-operation does not lead to collusive behaviour which restricts competition. This classical line of reasoning can be criticised for its limited scope and has not aligned with the changing character of market-based innovation systems, the growing understanding of the functioning of market-based innovation systems and insights derived from modern innovation theory. Nevertheless, cluster studies have also revealed the need to redefine the role of the government as a facilitator of networking, as a catalyst of dynamic comparative advantage and as an institution builder, creating an efficient incentive structure to remove systemic inefficiencies in systems of innovation.

Why then should governments have a role in strengthening or facilitating the emergence of strategic and innovative clusters? Our research programme actually revealed four rationales used in practice. The first pair are rather classical arguments, namely: creating favourable framework conditions for a smooth functioning of markets and the externalities associated with investments in R&D and more generally knowledge creation. The third argument refers to the fact that government itself is an important player in some parts of the economy. And the final argument can directly be linked to

14

the innovation system approach: governments aim at removing systemic imperfections in their innovation systems. Before discussing the changing role of the state in industrial policy making, we will briefly explain these four rationales for government interference.[10]

*The changing role of government: policy principles*
One could argue that establishing alliances and combining various skills in production chains simply takes place in the market. Following this line of reasoning the primary task of government would be facilitating the dynamic functioning of markets and making sure that co-operation does not lead to collusive behaviour which restricts competition. This fairly classical rationale can possibly best be summarised as *'creating favourable framework conditions'* to facilitate the smooth and dynamic functioning of markets e.g. by a vigorous competition policy, smooth macro-economic policy or regulatory reform.

A second well-known rationale for governments having a role to play are the externalities associated with investments in R&D and more generally knowledge creation.[11] The argument is that as long as the social rate of return on investments in R&D and knowledge creation is larger than the pure private rate of return on investments, these investments should be facilitated. If not, underinvestment in R&D would be the result. This is for instance the case in such fields as energy, the environment, infrastructure or large scale innovation projects on the Electronic Highway. This argument is also mentioned when publicly funded research in universities and public research institutes is discussed. Stimulating co-operation between firms on the one hand and the public R&D infrastructure (universities, research institutes) on the other might increase the social return on publicly funded R&D. More firms will be able to profit from public R&D efforts and the diffusion of knowledge can increase, especially towards SMEs. In most countries SMEs have not yet taken into account the benefits of increasing external linkages and sharing knowledge. Many SMEs are unaware of the opportunities that co-operation with other firms and knowledge institutes might offer.

A third rationale for government action in the field of innovation and industrial organisation is in a sense a classical one as well, namely the fact that *government in some markets is an important player itself.* This offers an opportunity to put pressure on the various market players to come up with innovative solutions to societal problems (like building bridges and roads, public transport, traffic congestion, pollution, health care and so on). In some countries it seems as if the good old argument of technology

---

[10] These four rationales are not specific for cluster policy making and can also be adopted in other fields. In this publication we limit ourselves to industrial policy making that aims at stimulating the emergence of innovative clustering.

[11] Research has shown that in most OECD-countries the social rate of returns on investments in R&D and human capital largely exceeds the private rate of returns (Mohnen, 1996).

procurement policies have been transformed into a public procurement policy with a view to enhance innovation; giving shape to the idea that a demanding customer might pull through innovations that otherwise would not have developed. These new style government procurement policies are not meant to support national industries in the first place, but to challenge firms and groups of firms (including firms from abroad) to come up with innovative solutions. For government itself it often means other ways of procuring projects e.g. by using different forms of contracting out, using functional instead of detailed technical specifications.

The competitiveness of a country's innovation system depends upon the synergy that arise from the interaction between actors involved in the innovation process. A rationale for economic policy, directly deduced from the innovation system approach, refers to removing *systemic imperfections*[12] which hinder the realisation of these synergies: informational and organisational failures and externalities. These systemic imperfections can, for instance, be the result of a lack of strategic information (on market developments as well as on public needs), bottlenecks in organising dialogue and co-operation between the various actors or environmental and knowledge externalities. This publication will show that most countries' industrial and innovation policy making actually focus on removing systemic imperfections and on improving the efficient functioning of their systems of innovation.

These policy responses to systemic imperfections encompass for example:
- establishing a stable and predictable economic and political climate,
- creating favourable framework conditions for the efficient and dynamic functioning of free markets and removing market imperfections,
- stimulating (the lack of) interactions and knowledge exchange between the various actors in systems of innovation,
- removing informational failures by providing strategic information,
- removing institutional mismatches and organizational failures within systems of innovation, like for instance mismatches between the (public) knowledge infrastructure and the private needs in the market or a missing demanding customer in the value chain,
- removing government failures and government regulations that hinders the process of clustering and innovation.

This listing clearly illustrates that the rationale of systemic imperfection clearly is broader than the old market imperfections arguments as the functioning of the innovation systems a whole is point of departure. Table 4 summarises the countries' cluster-based policy responses to systemic imperfections.

---

[12]     See also Boekholt and Thuriaux (1999), Porter (1997), Roelandt et al (1999), Rouvinen et al (1999), and Dunning (1997).

16

*Cluster policy in practice*
In practice countries' cluster policy approaches differ (see Annex 1 for a full review). One fundamental difference refers to the distinction between a *bottom up approach* on the one hand and a more or less *top down approach* on the other.[13] The first approach basically focuses on fostering dynamic market functioning and removing market imperfections and the starting point lies in market-induced initiatives with the government acting as a facilitator and moderator without setting national priorities (like for instance in the USA and The Netherlands). In the latter approach government (in dialogue with industry and research agencies) sets national priorities, formulates a challenging view for the future and - before starting the process of dialogue - decides on the actors to be involved in the dialogue process (like for instance in some of the Nordic countries). After having set national priorities and having initiated the dialogue groups the clustering process further is a market-led process without much government interference.

What countries' strategies in cluster-based policy can be discerned? Policy researchers[14] mention various government roles in cluster-based policy, for example:
- establishing a stable and predictable economic and political climate,
- creating favourable framework conditions for a smooth and dynamic functioning of markets (infrastructure, competition policy and regulatory reform, providing strategic information),
- creating a context that encourages innovation and upgrading by organising a challenging economic vision for the nation or region,
- raising awareness of the benefits of knowledge exchange and networking,
- providing support and appropriate incentive schemes for collaboration and initiating network brokers and intermediaries that bring together actors,
- acting as a facilitator and moderator of networking and knowledge exchange,
- acting as a demanding and launching customer when addressing needs,
- facilitating an arena for informal and formal exchange of knowledge,
- setting up competitive programs and projects for collaborative research and development,
- providing strategic information (technology foresight studies, strategic cluster studies),
- government should ensure that (public) institutions (especially schools, universities, research institutes) cultivate industry ties,
- governments can assure that rules and regulations maximise the flexible adaptation to changed market conditions and stimulate innovation and upgrading processes.

---

[13]   Boekholt and Thuriaux (1998).
[14]   See for example Boekholt and Thuriaux, (1999), Heath (1999), Rouvinen et al (1999), Roelandt et al (1999), Lagendijk and Charles (1999), Ormala (1997), Held (1996), and Porter (1997).

**Table 4 – Cluster-based policy response to systemic imperfections**

| Systemic imperfections | Policy response | Countries' focus in cluster-based policy making [15] |
|---|---|---|
| I. inefficient functioning of markets | • competition policy and regulatory reform | • most countries |
| II. informational failures | • technology foresights | • Sweden, The Netherlands, Germany |
| | • strategic market information & strategic cluster studies | • Canada, Denmark, Finland, The Netherlands, USA |
| III. limited interaction between actors in innovation systems | • broker and networking agencies and schemes | • Australia, Denmark, The Netherlands, |
| | • provide platforms for constructive dialogue | • Austria, Denmark, Finland, USA, The Netherlands, UK, Sweden, Germany |
| | • facilitating co-operation in networks (cluster development schemes) | • Belgium, Finland, UK, USA, The Netherlands |
| IV. institutional mismatches between (public) knowledge infrastructure and market needs | • joint industry-research centres of excellence | • Belgium, Denmark, Finland, Spain, Sweden, Switzerland, The Netherlands, Germany |
| | • facilitating joint industry-research co-operation | • Spain, Finland, Sweden, |
| | • human capital development | • Denmark, Sweden |
| | • technology transfer programmes | • Spain, Switzerland |
| V. missing demanding customer | • public procurement policy | • Austria, The Netherlands, Sweden, Denmark |
| V. government failure | • privatisation | • Most countries |
| | • get out of subsidy business | • Canada |
| | • horizontal policy making | • Denmark, Finland, Canada |
| | • public consultancy | • Canada, The Netherlands |
| | • downsizing government interference | • Canada, USA |

In general in a lot of countries the clustering processes have been initiated by the establishment of forums, platforms and regular meetings of firms and organisations related to a particular network of production in the value chain. Strategic information (technology foresight studies and strategic cluster studies) is often used as an input to the process of dialogue. The way this is actually organised differs between countries,

---

[15]   This table intends to indicate the most important characteristics of a country's cluster-based policy. A more comprehensive study to fill in the policy matrix is conducted by Technopolis. See Boekholt and Thuriaux (1998), and Boekholt and Thuriaux (1999).

depending on national traditions and culture in policy making, the way dialogue between industry, research and governments have institutionalised in a country, the scale and cope of the country and a country's level of government interference and the specific composition of economic activities and relevant technologies in a country's economy.

Clearly there are some *pitfalls* in cluster-based industrial policy making. These pitfalls indicate leading policy principles when designing a comprehensive cluster-based policy:[16]

- The creation of clusters should not be a government-driven effort but should be the result of market-induced and market-led initiatives.
- Government policy should not have a strong orientation towards directly subsidising industries and firms or to limiting the rivalry in the market.
- Government policy should shift from direct intervention to indirect inducement. Public market interference only can be justified if there is a clear market or systemic failure. And if there are clear market and systemic imperfections, it can not necessary be concluded that government intervention will improve the situation.
- Government should not try to take the direct lead or ownership in cluster initiatives, but basically should work as a *catalyst and broker* that brings actors together and supplies supporting structures and incentives to facilitate the clustering and innovation process.
- Cluster policy should not ignore small and emerging clusters; nor should it focus only on 'classic' and existing clusters.
- Clusters should not be created from "scratch" of declining markets and industries. Sometimes the notion of clusters is appropriated by (industrial) policy makers and used as an excuse to continue more or less traditional ways of defensive industrial policy making.

Reviewing the various policy initiatives in the participating countries reveals the following common *features of cluster-based policy* in OECD-countries:

- a vigorous competition and regulatory reform policy (almost all countries),
- providing strategic information by technology foresight studies (e.g. Sweden, The Netherlands), cluster studies (e.g. Finland, Denmark, Sweden, The Netherlands, UK, USA, Austria, Italy), special research groups (e.g. Denmark, the Austrian TIP-research programme, the German Delphi-report), or special websites (e.g. like STRATEGIS in Canada),
- broker and network agencies and schemes (e.g. The Danish network programme, The Dutch Innovation Centres),
- cluster development programmes (e.g. cluster programmes in Finland and The Netherlands, regional development agencies in UK, USA, Germany and the Flemish R&D-support to clusters),

---

[16]   See also Held (1996), Porter (1997), Roelandt et al (1999), Rouvinen et al (1999), and Dunning (1997).

- initiating joint industry-research centres of excellence (e.g. Belgium, Denmark, Finland, Germany, Spain, Sweden, Switzerland and The Netherlands),
- public procurement policy (e.g. Austria, Denmark and The Netherlands),
- institutional renewal in industrial policy making (e.g. Finland and Canada),
- providing platforms for constructive dialogue (e.g. the US focus groups, the Danish reference groups, the proposed Swedish industrial system approach, the UK regional development agencies, the Dutch broker policy, the Finnish National Industrial Strategy and the German Council for Research, Technology and Innovation).

Most countries use the cluster approach to organise a market-led economic development strategy by initiating dialogue between the various actors in their relevant systems of innovation. In much of the OECD-countries (USA, UK, Finland, Denmark, Sweden, The Netherlands) cluster-based policy is seen as a market-led business development strategy bringing together actors and organisations and fostering knowledge exchange and knowledge transfer. One common lesson from our cluster-based policy review is that cluster studies not only provide an analytic tool to analyse systems of innovation at the reduced scale level of networks, but in practice can also be used as a working method for policy-making and as an economic development tool for strategic business development.

## 4. The rising sun

In this paper, we have described the emergence of clusters as well as some different methods of its identification and analysis. In addition, we presented some implications for cluster policy at a national level, illustrated by some different approaches practised in various countries. The cluster concept as well as cluster-based innovation policy are still in a developmental stage and need further refinement. An interesting question for example is how clusters change. By systematically monitoring clusters over time, we can build a more in-depth understanding of these dynamic aspects of clusters. This is an important condition in order to be able to systematically evaluate cluster policy and improve on its effectiveness. The cluster concept also stimulates us to adopt new concepts on cooperation such as *public-private partnerships.* The essence of public-private partnerships is the cooperation of business and government in order to solve societal problems and at the same time strenghten the competitive advantage of a cluster.

The emerging network economy leads towards more tightly coupled, more intense, more persistent and more intimate relations among firms and between firms and governmental organisations (Kelly, 1997). The cluster concept embraces this new paradigm and helps us to understand it in a coherent and systematic way.

# References

Arvanitis, S., and H. Hollenstein (1997), *Innovative Activity and Firms Characteristics: An Exploration of Clustering at Firm Level in Swiss Manufacturing,* paper presented at the OECD-workshop on cluster analysis and cluster based policy, Amsterdam, 10-11 October

Bergman, E., and E. Feser (1999), *Industry Clusters: A Methodology and Framework for National and Regional Development Policy in the US,* in Roelandt and Den Hertog (eds) (1999)

Boekholt, P., and B. Thuriaux (1999), *Public Policies to Facilitate Clusters. Background, Rationales and Policy Practices in International Perspective,* in Roelandt and Den Hertog (eds) (1999)

Boekholt, P., and B. Thuriaux (1998), *Overview of Cluster Policies in International Perspective*, Technopolis, The Hague: Ministry of Economic Affairs (forthcoming)

Ceglie, G. (1999), *Cluster and Network Development in Developing Countries - The Experience of UNIDO*, in Roelandt and Den Hertog (eds) (1999)

DeBresson, Ch. (ed.) (1996), *Economic Interdependence and Innovative Activity,* Aldershot: Edward Elgar

DeBresson, Ch., and Xioping Hu (1999), *Techniques to Identify Innovative Clusters: a New Approach and A Toolbox*, in Roelandt and Den Hertog (eds) (1999)

Dreijer, I., F.S. Kristensen, and K. Laursen (1999), *Studies of Clusters as a Basis for Industrial and Technology Policy in the Danish Economy*, in Roelandt and Den Hertog (eds) (1999)

Dunning, J.H. (1997), *Alliance Capitalism and Global Business*, London: Routledge

Edquist, Ch. (ed.) (1997), *Systems of Innovation. Technologies, Institutions and Organisations,* London: Pinter Publishers

European Commission (1997), *Second European Report on S&T Indicators, Part IV,* Brussels/Luxembourg

Feser, E.J., and E.M. Bergman (1997), National Industry Clusters: Frameworks for State and Regional Development Policy, *Regional Studies,* August 6

Freeman, Ch. (1987), *Technology Policy and Economic Performance, Lessons from Japan*, London: Pinter Publishers

Hagendoorn, J., and J. Schakenraad (1990), Interfirm Partnerships and Co-operative Strategies in Core Technologies, in C. Freeman and L. Soete (eds), *Information Technology and Employment: An Assessment,* Science Policy Research Unit, University of Sussex

Hauknes, J. (1999), *Identifying Clusters: A Preliminary Input-Output Analysis for the Norwegian Economy*, in Roelandt and Den Hertog (eds) (1999)

Heath, R. (1999), *The Ottawa High Tech Cluster: Policy or Luck?*, in Roelandt and Den Hertog (eds) (1999)

Held, J.R. (1996), Clusters as an Economic Development Tool: Beyond the Pitfalls, *Economic Development Quarterly*, 10 (3), p. 249-261

Hove, N, van den, Roelandt, T., and T. Grosfeld (1998), *Cluster Specialisation Patterns and Innovation Styles*, The Hague: Ministry of Economic Affairs

Jacobs, D., and A-P De Man (1996), Clusters, Industrial Policy and Firm Strategy: A Menu Approach, *Technology Analysis & Strategic Management,* 8 (4), p. 425-437

Lagendijk, A, and D. Charles (1999), *Clustering as a New Growth Strategy for Regional Economics? A Discussion of New Forms of Regional Industrial Policy*, in Roelandt and Den Hertog (eds) (1999)

Lundvall, B.-A (ed.) (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter Publishers

Lundvall, B-A., and S. Borrás (1997), *The Globalising Learning Economy: Implications for Innovation Policy,* Draft report based on the preliminary conclusions from several projects under the TSER Programme, DG XII, Commission of the European Union

Marceau, J. (1999), *The Disappearing Trick: Clusters in the Australian Economy*, in Roelandt and Den Hertog (eds) (1999)

Meeuwsen, W., and M. Dumont (1997), *Some Results on the Graph-theoretical Identification of Micro-clusters in the Belgian National Innovation System,* Paper presented at the OECD-workshop on cluster analysis and cluster based policy, Amsterdam, 10-11 October

Metcalfe, J.S. (1995), Technology Systems and Technology Policy in an Evolutionary Framework, *Cambridge Journal of Economics,* 19(1), p. 25-46

Mohnen, P. (1996), R&D Externalities and Production Growth, *STI-Review,* Paris: OECD

Morgan, K. (1996), *Learning by Interacting. Inter-firm Networks and Enterprise Suppor,* in Local Systems of Small Firms and Job Creation, Paris: OECD

Nelson, R.R. (1993), *National Systems of Innovation: A Comparative Study*, Oxford: Oxford University Press

OECD (1996), *The Knowledge-based Economy*, Paris: OECD

OECD (1997), *An Empirical Comparison of National Innovation Systems.* Paris: OECD

OECD (1999), *Boosting Innovation: The Cluster Approach*, Paris: OECD

Ormala, E. (1997), *New Approaches in Technology Policy - The Finnish example*, paper presented on the OECD-workshop on Best Practices in Technology and Innovation Policy - New Rationales and Approaches in Technology and Innovation Policy, Vienna, 30/31 May

Padmore, T., and H. Gibson (1997), Modelling Systems of Innovation: A Framework for Industrial Cluster Analysis in Regions, *Research Policy*, 26 (6), p. 625-641

Pfeffer, J., and J. Salancik (1978), *The External Control of Organisations: A Resource Dependence Perspective.* New York: Harper Row

Porter, M.E. (1997), *Knowledge-Based Clusters and National Competitive Advantage*, presentation to Technopolis 97, September 12, Ottawa

Poti, B. (1997), *The Interindustrial Distribution of Knowledge: The Example of Italy,* paper presented at the OECD-workshop on cluster analysis and cluster based policy, Amsterdam, 10-11 October

Roelandt, T., P. den Hertog, J. van Sinderen, and N. van den Hove (1999), *Cluster Analysis and Cluster-based Policy in the Netherlands,* in Roelandt and Den Hertog (eds) (1999)

22

Roelandt, T., and P. den Hertog (eds.) (1999), *Boosting Innovation: The Cluster Approach,* OECD- Proceedings: Paris

Rouvinen, P. (ed.) (1996), *Advantage Finland. The Future of Finnish Industries*, ETLA-The Research Institute of the Finnish Economy, Helsinki

Rouvinen, P., and P. Ylä-Antilla (1999), *Finnish Cluster Studies and New Industrial Policy Making*, in Roelandt and Den Hertog (eds.) (1999)

Stenberg, L., and A-C. Strandell (1997), *An Overview of Cluster-related Studies and Policies in Sweden,* paper presented at the OECD-workshop on cluster analysis and cluster based policy*, A*msterdam, 10-11 October

Sulzenko, A. (1997), *Technology and Innovation Policy for the Knowledge-based Economy: The Changing View in Canada,* OECD Conference on New Rationale and Approaches in Technology and Innovation Policy, Vienna, May 31, 1997

Sweeney, S.H., and E.J. Feser (1997), Plant Size and Clustering of Manufacturing Activity*, Geographical Analysis,* May 19

Vock, P. (1997), *Swiss Position Paper for the Focus Group on Mapping Innovative Clusters of the OECD-NIS- project,* paper presented at the OECD-workshop on cluster analysis and cluster based policy*,* Amsterdam, 10-11 October

Vuori, S. (1995), *Technology Sources in Finnish Manufacturing*, Series B 108, Helsinki: The Research Institute of the Finnish Economy ETLA

Vuori, S. (1997), *Technology Sources and Competitiveness - An Analysis of Finnish Industries*, Helsinki: The Research Institute of the Finnish Economy ETLA

Yoshitimo, M. (1997), New Challenges for the Current Technology Paradigm in Japan, in OECD, *Creativity, Innovation and Job Creation*, Paris: OECD, p. 57-64.

**Annex 1 – Countries' strategies in cluster-based policy**

| Country | Approach | Cluster analysis | Policy initiatives/Policy principles |
|---|---|---|---|
| Austria | Systems of interdependent economic entities | • improving I/O-tables<br>• traditional statistical cluster analysis screening for patterns of innovative activities<br>• case studies | • cluster policy in design:<br>• framework conditions (regulatory reform, human capital development)<br>• providing platforms for co-operation and experimentation<br>• raising public awareness of technologies<br>• demand pull by public procurement |
| Australia | Networks of economic activity | • case studies of industrial districts (geographical propinquity) and resource based clusters<br>• i/o-analysis on inter-industry linkages | • no comprehensive cluster-based policy<br>• networking schemes encouraging the emergence of inter-firm networks |
| Belgium (Flanders) | Networks or chains of production, innovation and co-operation | • Graph analysis and case study work<br>• improving i/o statistics<br>• technology flows<br>• technology clubs (similar collaboration patterns) | • cluster-based policy under construction<br>• market induced cluster initiatives<br>• government facilitating co-operation<br>• subsidies and firms' co-financing in cluster programmes (in metal processing industry, plastics, space industry, SMEs, furniture)<br>• stimulating cross-sectoral technology diffusion<br>• supporting supplier-producer networks<br>• centres of excellence around newly emerging technologies |
| Denmark | Resource areas | • industrial districts / development blocks<br>• Porter-like cluster studies<br>• improving statistics<br>• cluster analysis as an input to the process of dialogue | • dialogue in reference groups<br>• centres of excellence in specific areas<br>• new educational programmes in specific areas<br>• development centres in specific areas<br>• top down approach (selected priority fields)<br>• institutional reform in policy making (co-ordination between ministries) |
| Finland | Clusters as a unique combination of firms tied together by knowledge and production flows | • Porter-based cluster studies | • clusters as an economic development tool<br>• identifying sources of competitive advantages in Finnish economy<br>• competition policy and structural reform<br>• creating advanced factors of production (basically creating favourable framework conditions)<br>• cluster programmes, strategic research, centres of excellence |

24

**• Annex 1 – Countries' strategies in cluster-based policy (Continued)**

| Country | Approach | Cluster analysis | Policy initiatives/Policy principles |
|---|---|---|---|
| The Netherlands | Value Chain Approach | • Porter-like cluster studies<br>• cluster benchmark studies<br>• input-output analysis | • dialogue in specific platforms<br>• brokerage and network policy<br>• public consultancy<br>• providing strategic information (a/o. technology foresight studies)<br>• renewal in procurement policy<br>• deregulation and competition policy |
| Spain | Inter-sectoral linkages and interdependency | • technology and innovation flow analysis | • framework policy<br>• stimulating R&D-co-operation and R&D-networks<br>• research centres (mixed private and public participation) and Science Parks. |
| Sweden | Interdependencies between firms in different sectors | • development blocks (in the 1950s)<br>• technological systems (late 1980s)<br>• network approach (since 1970s)<br>• Porter studies (since mid 1980s) | • cluster-based policy under construction<br>• general framework conditions<br>• technology procurement<br>• stimulating R&D co-operation<br>• research centres<br>• industrial systems project (is being set up) to stimulate strategic dialogue<br>• technology foresight studies identifying actual or potential innovative clusters |
| Switzerland | Networks of innovation | • case study work on restructuring system of production and innovation (Swiss Jura arc)<br>• analysing technological spill overs and innovation styles | • action programme for diffusion of specific technology (Computer Integrated Manufacturing)<br>• setting up competence centres integrated in regional networks |
| United Kingdom | Regional systems of innovation | • cluster case studies focus on identifying actors and development opportunities for the region | • clusters as a regional development tool<br>• government as catalyst and broker<br>• regional cluster programmes |
| United States | Clusters (chains of production) as a regional development tool | • cluster analysis focusing on the strengths and weaknesses of the local economic structure and identifying business opportunities<br>• cluster analysis used as an input to the consultation process<br>• input/output analysis combined with insight information from business | • dialogue in regional focus groups<br>• regional development plans |